

At the Vanguard of Commercial Water Conservation

Philip E. Paschke, Water Smart Technology Program Manager
Seattle Public Utilities, Seattle, Washington

Suzan Hill, Commercial Toilet Rebate Program Manager
Seattle Public Utilities, Seattle, Washington

Shelley Lawson, Water Efficient Irrigation Program Manager
Seattle Public Utilities, Seattle, Washington

Matt Chadsey, Water Reuse Program Manager
Seattle Public Utilities, Seattle, Washington

Executive Summary

Commercial water conservation programs managed by Seattle Public Utilities featuring customer based financial incentives have proven to be cost effective, able to produce real water savings, and have been popular with customers. Every program has delivered water savings at a levelized cost significantly lower than the utility's avoided cost of \$1.04/100 cubic feet (CCF) for new water supply sources. With the exception of Water Reuse, each program has developed methodologies of targeted program delivery that reduces administrative costs and maintains a steady flow of program participants. While the combined programs have saved nearly 4 MGD, with a commercial customer base averaging over 50 million gallons per day (mgd), significant conservation potential yet remains for these programs to continue having an impact on the utility's water supply resources.

Introduction

Seattle Public Utilities (SPU) delivers potable water to a region populated with 1.3 million people by both direct sale and through 26 wholesale water purveyors serving most cities and communities that encompass the Greater Seattle Metropolitan area.

A portfolio of water conservation programs initiated during the past five years, has allowed the utility to hold water demand constant while adding 5% in new customers to the total population served. Water conservation will continue to be relied upon to make significant contributions to the water supply portfolio of SPU.

This paper focuses on four commercial water conservation programs that, over the past five years, have saved/added 4 million gallons per day to the supply system at a levelized cost well below the avoided cost of new supply sources. These four programs have each produced long term, reliable water savings:

- Commercial Toilet Rebate Program
- Water Smart Technology
- Water Efficient Irrigation
- Water Reuse

Each program effort is unique in its own way. In the subsequent pages, program results and how they were achieved will be fully discussed including statistical information, and the cost and benefit from both the utility and customers perspectives.

The Commercial Toilet Rebate Program (CTRP)

Background

Water used for flushing toilets and urinals accounts for the single largest, year round demand for water in the Seattle area. Pre-1975 toilets use 5 or more gallons per flush (gpf); since 1975, most toilets use 3.5 to 5 gpf. Pre-1993 urinals flush 3 to 3.5 gallons although many older models use more than 3.5 gpf or are "continuous-flush" types. Further, because the fixtures have a long life time (20 years or more), fixtures are not routinely replaced and/or maintained like other consumer products. Many older fixtures are likely to be leaking or "running".

In July 1993, the new statewide plumbing code became effective requiring that all toilets sold or installed in Washington use no more than 1.6 gpf and urinals use no more than 1 gpf. As new construction and remodeled buildings replace existing fixture stock, water use will become more efficient. However, the majority of existing fixtures were installed prior to the new plumbing code and the savings resulting from the plumbing code change alone could take 15 years or more to be fully realized. Although toilets are found in both the residential and non-residential sector, targeting those fixtures that are used most frequently for participation in a rebate program results in greater least-cost savings. An incentive program for the non-residential sector to promote toilet replacement was important for the following reasons:

- ❖ Toilets account for the single largest use of domestic water -- fixtures installed prior to the 1993 code are estimated to account for 7 to 8 million gallons per day (gpd) of water use.
- ❖ Each of the fixtures replaced use approximately 60% less water (based on existing fixtures using an average of 4 gpf).
- ❖ Fixtures in the targeted non-residential sector are each flushed an average of 30 or more times a day -- more than three times the average daily use in the residential sector.
- ❖ Urinals are in the non-residential sector -- water efficient urinals use 1 gpf or less.

The specific goals of the Commercial Toilet Rebate Program were to:

- ◆ Acquire 1.1 mgd annual savings in water consumption by the end of 1997 at a levelized cost of \$0.76/CCF.
- ◆ Replace 12,285 fixtures, each with an average savings of 85 gallons per day, by the end of 1997.
- ◆ Ensure equitable representation of purveyor customers participating in the program.

The full-scale program, implemented on April 1, 1995 was designed based on the results of a comprehensive pilot conducted between September, 1994 and February, 1995. The purpose of the pilot program was to determine effective methods of targeting; program marketing and promotion; rebate levels and process, and savings evaluation.

The pilot offered rebates of \$135 for toilets and \$160 for urinals replaced in buildings which were built prior to 1993. The pilot was marketed through a limited direct mailing to approximately 1,700 targeted restaurants, taverns, entertainment facilities and members of the Building Owners and Managers Association. The pilot resulted in a total 660 fixture rebates to 61 business or building owners.

An evaluation of the pilot showed that the program would produce savings at \$.76/CCF, which is well below the marginal cost of water (\$1.04/CCF). However, the pilot rebate levels produced a slightly negative impact on non-participating rate payers due to the fact that they incur as costs the rate impacts of the utility's direct program cost plus the revenue needed to make up for the participant's reduction in utility bills. Thus, at the pilot rebate levels, non-participants did not share in the positive net benefits potentially available to all ratepayers from the program. Adjusting the rebate levels could correct the negative impact on non-participants.

Customers were very satisfied with the pilot program and indicated that the level of rebate could be lowered and still maintain their program interest. Another factor that was examined was the customer's percentage of the overall cost to replace fixtures after receiving the rebate. The total cost of replacing flush-valve fixtures is substantially more than replacing tank-type toilets. Therefore, customers replacing tank-type toilets paid less than 50% of the total cost, while those replacing flush-valve fixtures paid substantially more than 50%. For those reasons, the rebates for the full-scale program were revised to \$100 for each tank-type toilet replaced and \$150 for each flush valve toilet and urinal replaced.

Program Description

This program is offered to eligible commercial customers within Seattle's direct and wholesale purveyor areas. It was originally scheduled to be implemented over four years, beginning in January, 1994, but was initially delayed while studies were completed on performance issues relating to wall-mounted type toilets frequently found in commercial restrooms. Based on the evaluation of the pilot, changes were made to the program design and the full-scale program was kicked-off on April 1, 1995.

The program offers cash rebates to businesses and public institutions with frequently used toilets and urinals that replace existing fixtures with low flush toilets (1.6 gpf) and urinals (1.0 gpf). To qualify for a rebate, each fixture must be used at least 30 times a day. In general, this would be the case for any non-residential customer who has restrooms that are used by the public or by employees. Existing fixtures must use 3.5 gpf or more to qualify.

Approved applicant's receive up to \$100 for installing each 1.6 gpf tank-type toilet and \$150 for installing each flush valve fixture (valves must be 1.6 gpf for toilets and 1.0 gpf or less for urinals). At no time will the rebate amount exceed the customer's total replacement costs. When replacing a flush valve fixture, both the bowl and valve are required to be replaced to qualify for a rebate. Installing valve retrofit kits, valve diaphragms or making valve adjustments do not qualify for a rebate.

Participants are required to complete and submit a program application form for each building or business in which efficient fixtures will be installed. The information provided on the application form is used to confirm their eligibility. Once the application is approved, the customer is sent a rebate packet which includes complete program guidelines and instructions. In order to receive the rebate, participants need to install certified water efficient fixtures within 90 days, legally dispose of the old fixtures and submit a rebate request along with proof of installation, purchase receipts, and plumber invoices. Rebate checks are issued within 30 days after the completed forms are received. Approximately 60% of the completed applicants have a site inspection performed to verify eligible fixtures were installed.

Marketing

Target Markets - All commercial, industrial, and institutional customers of Seattle Water and its twenty-six purveyors are eligible for the Commercial Toilet Rebate Program. For purposes of targeting promotional efforts, non-residential customers can be segmented into two basic groups based on the amount of use their fixtures receive. Primary targets are those customers which have fixtures that have a high frequency use rate - 40 or more times a day each. Secondary targets are those customers with fixtures that are used an average of 30 or more times a day, but whose use may fluctuate based on the number of employees, amount of business taking place or seasonality. The following is a list of examples of primary and secondary targets:

Primary Targets

- ◆ Public parks and facilities (museums, public swimming pools, libraries, etc.)
- ◆ Entertainment Centers (bowling alleys, theaters, skating rinks, etc.)
- ◆ Restaurants with extended public hours (open 24 hours per day)
- ◆ Taverns/bars with live entertainment
- ◆ Office Buildings with a high occupancy vs. fixture ratio.
- ◆ Shopping malls

Secondary Targets

- ◆ Small restaurants/cafes
- ◆ Retail stores
- ◆ Industrial complexes
- ◆ Gas stations
- ◆ Office buildings
- ◆ Medical/dental clinics
- ◆ Hair salons

Six basic marketing techniques were identified to reach the primary and secondary targets. They were trade allies, recognition stickers, trade shows and presentations, direct mail, advertising and public relations, and personal recruitment. While all of these techniques were used to some degree, direct mail has proven to be the most effective and least cost approach, given the diversity of customer classes and the large numbers of target customers. Careful selection of mailing lists provides the opportunity to target our potential market segments. A direct mail piece also offers an opportunity to track responses and provides sufficient details on program requirements.

A detailed program brochure was developed which describes the program, eligibility criteria and answers questions on the products available. A program application form is also attached. This attractive self-contained piece provides customers with all the information they need about the program. However, given the cost of the piece and the additional postage cost, it is not effective as a mass mailer. A second promotional piece, a post-card with a self mail reply-card, was also produced for the purposes of mass mailing. The post-card provides enough information about the program to motivate eligible and interested participants to request further information and a program application.

Evaluation

There have been several evaluation efforts related to the CTRP. The first was an impact evaluation that was used in the evaluation of the pilot program. The second was a fixture performance evaluation that was conducted in response to concerns about the performance of low volume flush valve fixtures in commercial high rise buildings.

The third is an on-going customer satisfaction survey of program participants. The following briefly describes these evaluations and their subsequent results.

Impact Evaluation

A metering study was conducted in two businesses that participated in the pilot phase of the CTRP. A total of eight fixtures were metered for 6 weeks prior to the installation of new low volume fixtures. After installation, the new fixtures were then metered for another 6 week period. The metering verified that there was an average savings of 79 gallons per day for toilets and 99 gallons per day from urinals. This information was used to fix an average per fixture savings of 85 gpd.

Performance Evaluation

The performance study examined twenty participant sites over a ten day period in September, 1996. Included in the study were twelve office buildings, one restaurant, one medical building, one teaching facility, one medical laboratory, one community center, one retirement home and two entertainment facilities. Of the one thousand, eight hundred and twenty toilets in these buildings, sixty-six (4%) were tested for flush performance characteristics. Forty-seven were in men's restrooms, fifteen in women's and four were in restrooms used by both sexes. All the toilets tested were of the flush valve type (not gravity) and all but three were wall-hung models.

The site work consisted of two parts. An interview with maintenance personnel (survey) and the performance tests (metering of static pressure, flow pressure, peak flow rates, total flow rates and flush valve cycle time). There were seven issues addressed in the surveys. They were double flushing, clogging at the trapway, drainline blockage, splashing, bowl cleaning, total performance and overall satisfaction with the retrofit. Of these issues, only double flushing was reported a problem for the majority of respondents. This was very interesting given the fact that most sites reported water savings, some as much as 30% reduction.

The results of the performance testing were inconclusive. The most incontestable conclusion that was reached was that good performance (or lack thereof) of these low consumption fixtures is inconsistent. The actual factor or combination of factors that cause one toilet to perform extremely well and another to perform poorly, in a given set of circumstances, is still unclear. However, it was determined that flush performance is not strictly dependent on the mechanical functioning of the valve and bowl, rather the total flush performance is a complex combination of factors, including user habits.

This study did result in some very useful information. As a result, a brief was developed that described the basic issues relating to toilet performance and made recommendations for 1.6 gpf installations in commercial settings. This brief is provided to customers, along with the program brochure, prior to their participation.

Customer Satisfaction Survey Summary

215 Surveys mailed (all applicants who completed installations prior to September 1, 1997)
163 Responses (76%)

73% of the respondents said that the rebate amount was a **very important** factor in deciding to participate in the program **and 73%** indicated that utility bill savings was **very important**.

90% of the respondents felt the rebate process was **very easy**, **84%** said that utility staff was **very helpful**, and **77%** felt the program information and instructions were **very helpful**.

95% of the respondents received their rebate checks **within 3 weeks** of submitting a rebate request.

71% of the respondents said that they were **not very or not at all likely** to have replaced fixtures within the next two years without the help of this program.

60% of the respondents felt their utility bills had been **reduced by 10% or more** as a result of replacing fixtures, while **5%** said their bills have been **reduced by 50% or more**.

77% of the respondents **were very satisfied overall** as a participant of the program.

Participation Results (As Of 10/1/98)

Number of Participants:

Seattle Public Utilities Participants	-	462
Purveyor Utility Participants	-	<u>240</u>
Total Number of Participants	-	702

Number of Participants By Type:

Office Buildings	-	221
Commercial/Industrial	-	42
City/Government	-	12
Schools	-	112
Restaurants	-	88
Churches	-	25
Small Businesses	-	202

Number of Fixtures Installed:

Total No. Of Toilets Installed	-	9,315
Total No. Of Urinals Installed	-	<u>2,464</u>
Total No. Of Fixtures Installed	-	11,779

Number of Fixtures Pending Installation

Total No. Of Toilets Pending	-	3,605
Total No. Of Urinals Pending	-	<u>872</u>
Total No. Of Fixtures Pending	-	4,477

Original Estimated Goals/Savings

Total Fixtures Installed	-	12,200
Estimated Water Savings	-	1,037,000 gallons per day

Actual Goals & Savings Achieved To Date

Total Fixtures Installed	-	11,779
Actual Water Savings	-	1,001,215 gallons per day

Water Smart Technology

Background

The Water Smart Technology Program (WST) provides the opportunity for industrial, commercial, and institutional (ICI) customers to achieve water savings with any assortment of cost effective end use measures. Whereas the other three programs were designed to be more limited in scope focusing on specific end uses, or a potable water substitute in the case of reuse, Water Smart Technology's scope is the entire ICI sector and the variety of end uses. Up to the beginning of 1997, each prospective project was evaluated on an individual basis for determining cost effective water conservation opportunities. Recognizing certain administrative benefits, WST began at that time to offer standard rebates for a specific end use in the same fashion as Commercial Toilets. WST remains a program offering the greatest percentage of financial incentive awards based on the customized analysis approach.

Program Operation

Day to day program operation is handled by a single program manager. Projects are conceived through a number of different approaches, but by and large WST is a vendor driven program. This means the majority of projects begin through a contact made by an equipment vendor, mechanical or refrigeration contractor, or HVAC service contractor. This program delivery method minimizes the expense of marketing, program administration, and false leads that can sometimes result through other forms of outreach. Opportunities for marketing the program in trade shows, speaking engagements, paid advertisements, and articles in local trade journals or newsletters have not been neglected, but generally do not provide a steady supply of projects.

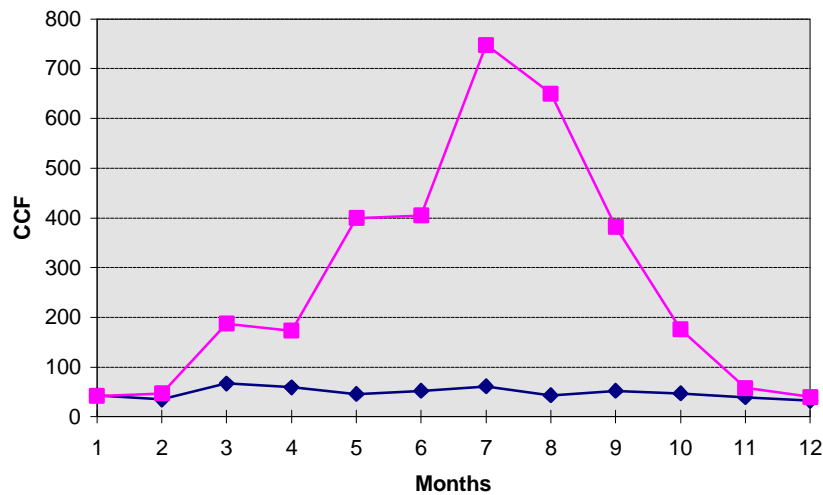
Project Analysis

When an application/proposal is received several determinations are made regarding the level of analysis required. Historical water consumption is first reviewed. Questions that must be answered involve knowing the nature of water use at the facility; daily and seasonal patterns; load factor of the equipment; water flow rates for cooling, refrigeration, or other processes; number of employees, and so on. The goal is to arrive at your best estimate for total water use of the facilities end uses, and what can be expected in water savings from any recommended measures.

With the analysis of estimated water savings completed, the numbers are formulated into a spreadsheet that calculates water & sewer rate savings for the customer, the levelized cost/CCF, the net present value & benefit/cost ratio versus the avoided cost of water. A simple payback and internal rate of return is also calculated as are ratepayer impacts in the form of net present value to non-participants. If the project is cost effective, defined as a levelized project cost less than avoided cost of a new water supply, then the project would be eligible for a financial incentive.

Level One Complexity: The key to reliable water savings is this up front analysis. The complexity of the project, the expertise of the customer, and the conservation technology involved all contribute to the desired level of analysis. One example of a basic project, replacing a single pass air conditioning unit with air cooled in a building with no other large water uses would call for a simple bill analysis to establish estimated savings. Annual consumption and post project consumption should look something like this:

Single Pass AC



The reliability of the estimated savings in most completed projects such as this have proven to be extremely good.

Level Two Complexity: A large facility with a variety of equipment or a complex process requires additional analysis. An excellent example of this is a hospital. A simple bill analysis will not be adequate to form the basis of a conservation estimate, nor will it provide much post evaluation support. Submetering the existing end use(s) becomes the next choice to establish a baseline.

An illustration of this was a large hospital using an average of 180,000 gpd. The hospital had expressed interest in pursuing a number of the water conservation measures recommended in a consultant's water conservation report. With SPU providing water meters, hospital staff installed three submeters where current use could be monitored on two single pass air conditioning systems, and one liquid ring vacuum pump. Regular meter readings provided an end use profile demonstrating potential savings.

Where water meters are not a feasible or practical, another method of data collection for anything involving a motor is the use of a motor logger. This little device records hours of operation on any motor and can be utilized in almost any situation. When combined with a flow measurement from the bag and stop watch method, a high quality set of water use data can be produced.

Considering the time and expense involved in field data collection, engineering calculations are the next and sometimes most preferable analysis tool. A few vendors utilize a simple computer program specifically designed for determining gallons per hour for a water cooled machine. Short of this however, collecting basic information such as compressor horsepower, Btu capacity, incoming water temperature, and the same calculation can be completed by hand resulting in a reliable estimate of water savings.

Level Three Complexity/Expense: The highest level of project analysis, and most expensive, involves the use of a consultant. In the previous hospital example, all three levels of analysis were used. The benefit to a paid consultant, normally a licensed professional engineer, is they're ability to evaluate the most complex systems. In an industrial process or large and complex HVAC system, the recommendations might be obvious; save water in process X; but how to get there, and understanding how changes will affect a complex system is where outside help can be invaluable. In SPU's case consultants are utilized for only the most complex project or facility; or in the case of a new or innovative and relatively untested technology. SPU has cost shared consultant studies for two hospitals, a brewery, ten Seattle Park's Department swimming pool facilities, several federal buildings in one study, and two consultants specializing in cooling tower performance. Expenditures for consultant contracts has totaled \$78,871.00 over the five year program existence.

Results

Results are what we are all after; let's evaluate SPU's acquisition of water conservation savings from WST. From 1994 through 1996, all projects were custom incentives. Beginning in 1997, standard rebates were included as part of the program mix for water cooled ice machine replacements only. This served to increase the frequency of this measure many times over. Only 13% of ice machine projects were completed prior to 1997. (Ice machine projects are presented in *table one*). Because of the heavy mix of ice machine projects since introduction of a standardized rebate, it could be argued that this represents a cream skimming methodology, and in some cases that criticism would be justified. However, by taking advantage of rebates for toilets and ice machines, many of the small businesses participating, generally in food service, are implementing their most compelling water conservation opportunities, with mostly behavioral efficiencies remaining for real savings.

Project Description	Sum CCF	Sum GPD	Avg GPD	Bill Savings	Avg Savings	Avg LC	Sum Of Cost	Avg Cost	# of projects
Water cooled ice machine	20,979	43,704	950	\$105,472.00	\$2,292.87	\$0.84	\$171,707.94	\$3,732.78	46

(Table one)

Tables two and three are summaries of most completed projects, excluding ice machines, with at least a one year post billing history available. The amount of financial incentives paid directly to customers through 9/98 totals over **\$1.5 million dollars**. The actual savings produced are based on SPU metered water consumption before and after measure installation. The pre meter reading are almost always an average of at least two years and sometimes more. Post project reading vary from one to three years as identified. The handful of projects showing a negative percentage means billed water consumption has increased since the project was completed as compared to the pre project average, and what the post project consumption should have been if the estimated savings would have occurred.

SMALL FACILITIES (<5,000 CCF/YEAR)

	Pre Project CCF Meter Consumption	Post Project CCF Meter Consumption	Actual CCF Savings	Percent of Estimated Water Savings
	(minimum 2 year avg.)	minimum one year		
Water cooled AC	2,100	676 ***	1,424	95.0%
Water cooled chiller	2,026	332 **	1,694	121.0%
Water cooled chiller	3,484	360 **	3,124	98.0%
Water cooled chiller	3,629	250 **	3,379	111.5%
Water cooled refrigeration	3,704	824 *	2,880	196.7%
Process cooling	2,494	400 **	2,094	210.0%
Foundry process	3,258	1456 *	1,802	100.0%
Industrial vacuum pump	4,416	222 **	4,194	112.0%
Water cooled refrigeration	3,188	2483 *	705	137.0%
Water cooled refrigeration	1,194	156 **	1,038	131.0%
Water cooled AC	1,812	193 *	1,619	102.4%
Process cooling	2,129	387	1,742	89.0%
Water cooled refrigeration	1,741	1,457	284	64.5%
Water cooled refrigeration	1,269	396 *	873	205.0%
Water cooled AC	2,453	1,662	791	64.8%
Water cooled AC	1,630	565	1,065	82.6%
Total	28,708			
	* Two year post consumption history **Three year post consumption history ***Four year post consumption history			

(table two)

LARGE FACILITIES (>5,000 CCF/YEAR)				
	Pre Project CCF Meter	Post Project CCF	Actual CCF	Percent of Estimated
	Consumption	Meter Consumption	Savings	Water Savings
	(minimum 2 year avg.)	(minimum one year)		
Aquaculture	191,612	29,018**	162,594	99.6%
Water cooled refrigeration/AC	9,702	6,738	2,964	86.5%
Water cooled refrigeration/ice machine	7,040	6,038	1,002	94.7%
Laundry water reuse	8,003	7,454	549	120.0%
Laundry water/ice machines/showers	9,166	9,610	-444	-29.0%
Laundry water reuse	28,448	28,848*	-400	-1.4%
Laundry water reuse/ice machine	13,885	11,384**	2,501	199.0%
Vacuum/pump, cooling, domestic^	88,432	50,176	38,256	144.5%
Water cooled compressors	122,733	87,018*	35,715	196.0%
Single pass fountain recirculation	17,539	50*	17,489	199.0%
Single pass HVAC/dental vacuum	64,095	22,439	41,656	94.0%
Cooling tower for single pass^	30,711	22,702**	8,009	136.8%
Lube oil coolers/urinals/aerators^	19,365	11,525*	7,840	250.0%
Laundry water reuse	26,295	23,336**	2,959	101.0%
Single pass refrigeration^	14,428	13,353*	1,075	200.0%
Single pass refrigeration	16,476	10,451*	6,025	510.0%
Liquid medical air/vacuum to air	103,368	92,082	11,286	123.7%
Single pass refrigeration	17,568	18,019	-451	-5.8%
Single pass refrigeration^	12,945	5,463**	7,482	259.0%
Bus wash recycling system	12,385	2,166	10,219	100.0%
Heat exchanger - winery^	16,174	9,161	7,013	1020.0%
Total			363,339	
^ Other measures installed outside of Water Smart Technology				

(Table three)

What the results demonstrate is that water savings are plentiful in most cases. The levelized cost for projects has easily beaten the cost of new water supply, especially when calculated from actual savings versus estimated savings. The trend has been for actual savings to have exceeded estimated savings by a large percentage in many projects. The reasons for this are likely many, and some can be identified with varying degrees of certainty. In several cases, this is the result of other measures being implemented, especially low volume bathroom fixtures. The authors know this to be the case, but have not corrected for it in this table of results. In other cases estimates were kept conservative to reduce the chance that savings would be less than predicted, especially in the case of newer technology, or in large facilities where savings can be difficult to demonstrate because of the volume of water consumed by large facilities every day. A third reason is very likely to be the water equipment itself. In single pass refrigeration equipment especially, it is quite common for a pressure control valve to malfunction resulting in a constant flow of water, even when the compressor is cycling off. Unless the equipment is servicing a constant 24 hour/day load, water flow should shut down when the equipment cycles off. When this does not happen, water use becomes very high and some customers may believe this is normal operation. Usually this does not go uncorrected

for a long time, but could affect water use significantly during any one year resulting is skewed pre consumption averages. And finally, without actual metering or motor logging, the load factor on the equipment may simply be underestimated, or other assumptions necessary to make a calculation may be too conservative.

Finally, *table four* shows results from the most common projects. By combining the results for categorized measures projections and expectations for future results become more reliable.

Project Description Laundry	Sum CCF	Sum GPD	Avg GPD	Bill Savings	Avg Savings	Avg LC	Sum Of Cost	Avg Cost	# of project s
New machine reuse	1,131	2,319	1,160	\$5,680.00	\$2,840.00	\$0.78	\$16,011	\$8,005	2
Laundry filtration system	29,278	60,000	60,000	\$148,543.00	\$148,543.00	\$0.86	\$300,000	\$300,000	1
Laundry reuse system	18,990	38,914	5,559	\$86,169.00	\$12,309.86	\$0.85	\$259,827	\$37,118	7

Project Description Single Pass	Sum CCF	Sum GPD	Avg GPD	Bill Savings	Avg Savings	Avg LC	Sum Of Cost	Avg Cost	# of project s
Single pass AC	33,083	67,798	5,215	\$166,146.00	\$12,780.48	\$0.90	\$395,430	\$30,417	13
Single pass AC/refrigeration	2,668	5,467	5,467	\$13,398.97	\$13,298.97	\$1.07	\$32,092	\$32,092	1
Single pass refrigeration	7,904	16,170	1,617	\$39,694.71	\$3,969.47	\$0.62	\$79,214	\$7,921	10

(table four)

Case Highlights

It is often most helpful to examine not only the spectacular successes, but failures as well. The WST program has had at least one or two spectacular successes each year. Quantity of savings doesn't necessarily have to be the determining factor to judge a project's success; it could be a new technology, a particularly wasteful process, or a customer making that extra effort to become more water efficient. Following are several projects of merit, not all of which have a year or more of history, but nonetheless are noteworthy in their success or failure.

National Marine Fisheries: The largest conservation project to date. This was a particularly significant project for not only water savings of over 300,000 gpd, but energy savings as well. The project won a national energy efficiency innovation award from the Department of Energy.

This facility is geared to marine organism research, primarily salmon. Up to one-half million gallons of potable water per day was used in the rearing of fish for research purposes. All of this water flowed through once and was discharged to local surface waters. Water conservation was only one of several goals in designing and implementing a water recycling system. A significant amount of energy went into water cooling, water quality control was an issue, and a higher level of research control was desired.

This recycling system consisting of biofiltration, UV treatment, and ozone disinfection was designed entirely by scientists at NMF. A tremendous amount of research was involved in system layout, equipment selection, treatment protocols and scheduling, and system controls including flow, temperature, and quality.

The results have proven the system will withstand the test of time. Completed in late 1995, the system is producing the desired results. Including the year 1995, when research was curtailed due to construction of the system, actual savings have reached 86% of estimated. Excluding 1995, 99.6% of estimated savings are being achieved.

The participants involved in this project were highly motivated, dedicated to success, and very cognizant of what the results would demonstrate to the scientific community. This high level of customer motivation and involvement might be the single most important element of a successful project, especially in projects of increasing complexity.

Medical Dental Building: This is a private sector project involving an 18 story office building devoted entirely to health care professionals. Tenant spaces are occupied by doctors, dentists, chiropractors, and various other related health care providers. The building's HVAC system was mostly a combination of air to air heat pumps and water to air heat pumps. Each tenant is responsible for the system in their space. Buildings management paid the water and energy bills. The project focused on the water to air systems. The approximately 40 individual space units did not operate on a hydronic loop, but with a non-recirculated potable water source. Essentially a single pass water loop provided the heat source or sink depending on what the space conditioning needs called for. Water consumption for this building was extremely high as compared to other similar sized buildings with recirculated hydronic systems. Water use averaged about 140,000, with some months exceeding 200,000 gpd.

The building manager recognized that with rising utility rates, this was becoming a significant cost of doing business. The two options available involved either billing each tenant for water, or replacing all the water to air units. The WST program made conservation the first choice, and this has turned out to be a very good choice.

Analysis of this project would be a challenge. Water use in health care can be extremely varied and difficult to quantify. Many of the dentists utilized liquid ring vacuum pumps, a few still had constant flow spittoons as well. And with the large number of patient visits, how much could be attributed to just bathroom use? Water use by the HVAC units was significant, but how much of the total consumption? As it turned out, submetering several of the individual space units, as well as selected bathroom facilities, provided the answer. Six units were metered for a period of one month to provide the data that formed the basis of a water savings estimate, and to provide the evidence that the project would be cost effective.

Submetering the bathroom fixtures proved that locked bathrooms, even with the high number of building occupants and patients, does not necessarily equal high use, so a second conservation measure of installing low volume toilets was not implemented. A third measure, implemented on the heels of the HVAC unit replacements, involved installing a recirculation device on the dental vacuum pumps. Once again metering proved very useful as four individual units were metered before and after to establish if retooling the remaining units, numbering close to 60, was desirable. The data from this metering proved that the device worked and that up to 70% of water could be saved very cost effectively.

The results on this project have been very good. Although just 94% of estimated, this correlates to an average building water use reduction of 65%. The outstanding motivation demonstrated by building management once again was a significant element to the success of this project, as was recognized by a Northwest Region AWWA Conservation Award.

Hospital Central Services Association: The reason for this third case highlight is because it demonstrates not only the importance of motivation, but in the case of an industrial laundry process, or any process for that matter, the participant must also have a high level of knowledge about the process in order to select the right technology, be able to operate and maintain the equipment, and also be able to predict to some degree of accuracy how the technology

will compliment the existing process or be able to make to right adjustments to most effectively utilize the process. This project also demonstrates it can make sense for the utility (SPU) to take an occasional risk.

This facility processes the laundry of 11 local hospitals through a cooperative membership association. A laundry of this size, processing over 20,000,000 pounds of goods per year can be considered an industrial process. Water chemistry is critical to producing a high quality final product. While laundry recycling systems are not new, this project is worth studying because the customer implemented a filtration system that had never been proven on a laundry application. After product research and testing, the system known as a VSEP filtration system was selected not only because the customer and an outside consultant determined that it offered the best potential for success, but due to space constraints, it also offered the desired performance in a small footprint package.

There were still unknowns however, with how the water chemistry would react from a high percentage of recycling. The only way this could be determined was a full scale production test. The customer at that point requested SPU share the financial risk. The test would cost over \$100,000. After careful analysis, SPU agreed to contribute \$25,000, and if successful, would contribute another \$100,000 to the project depending on actual water savings results. If the system did not meet expectations, that would be the end of it. The customer would continue without a recycling system, and SPU would have nothing to show for it's \$25,000. The test was a success however, and the system has actually exceeded expectations. Surprisingly, this technology has led to benefits not originally anticipated by providing softer water, which in the laundry business is good for washing clothes. With the addition of a CO2 injection to lower pH, an additional 10,000 to 15,000 gpd savings is estimated by the customer. The initial projection was for savings in the 50 to 60,000 gpd range is being met with an average of 55,000 gpd during the first two months of operation. This was good enough to qualify for the second level financial incentive, a performance spec unique to this project. If the CO2 works to lower pH enough to generate savings in excess of 60,000, the maximum financial incentive for this project will be awarded.



System as installed

Hotel: Not every project is an automatic success story. One hotel belonging to a nationwide chain with a motivated manager was very interested in water conservation. Several measures to implement were identified:

- Replace three water cooled ice machines
- Replace leaky bath/shower valves
- Laundry water reuse

The customer agreed to implement all three and this was accomplished. The first year results have not demonstrated savings. One year post installation water use has increased slightly even though single pass water cooled ice machines were eliminated, very leaky shower cut-off valves were repaired, and a laundry rinse water system was installed that saves about 30% of total laundry water use. During a follow up evaluation with the hotel manager, the apparent lack of results can be found in an overall increase of occupancy rates by 5-7% on an annual basis over the last couple years. The manager is actually very please with the performance of each measure. The other mitigating in the lack of apparent savings is that during the first post year, the region endured a prolonged hot and dry spell that will typically increase water use. Adjustments for irrigation cannot be made for this property as an irrigation meter does not exist.

What this case highlights is the difficulty in always demonstrating water savings. When only utility meter readings are relied on to provide verified savings, there will be cases that appear to have failed. Only time will tell whether the utility will "see" any savings from this project.

Water Efficient Irrigation

Background

Seattle Public Utilities and its wholesale customers have operated the Water Efficient Irrigation Program since 1995. This program helps large commercial irrigators by identifying and funding irrigation improvements. So far, the program has achieved water savings at a cost significantly less than the utility's cost for new water supply. Customers often receive additional benefits from reduced labor costs and improved landscape health.

The program provides participating customers with 1) a site assessment or audit, 2) a written recommendation, and 3) a financial incentive payment to carry out the recommendations. Many types of large irrigators have participated in the program, including cemeteries, multifamily complexes, office parks, public parks, and schools. Water savings per customer range from an average of 2,000 gallons per day for public parks to 30,000 gallons per day for cemeteries, with bill savings from \$800 to \$12,000 per year. As a result of the work done from 1995-1998, the program projects saving 116,960 gallons per day over 15 years at a levelized cost of \$0.85 per CCF. These calculations use a combination of estimated and actual measured savings.

Program Description

The program structure is:

Determination of Site Eligibility: Commercial Site with irrigated landscape (a minimum of 1 acre)

Program components:

- Site Assessment or Audit: Utility staff or consultant will visit the site and conduct an assessment of the irrigation system. Occasionally staff will conduct an actual audit where appropriate. Additional information on management of the system, such as sprinkler run times and maintenance practices, is gathered
- Written recommendations: After the site assessment, SPU staff will write up a list of recommendations for improving the water efficiency of the system. The reports generally have two components: management improvements and capital improvements. The management improvements are recommendations for changes in

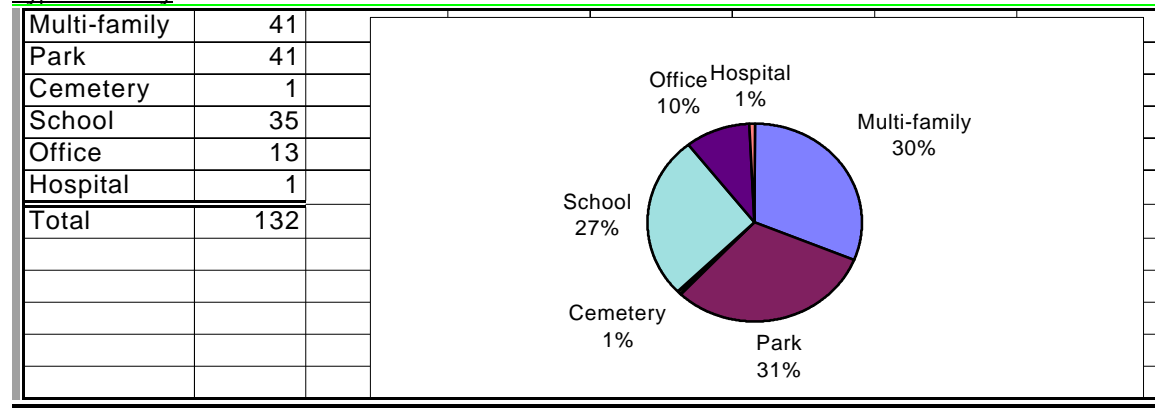
the management of the system that will save water. The capital improvements are actual replacements of the irrigation system hardware with more water efficient equipment.

- Financial Incentives: Customers can apply for financial incentives for any improvement that saves water. Sites make many improvements based on the Site Assessment recommendations. However some sites make retrofits without prior recommendations. A site assessment is not a requirement for a financial incentive payment.

Summary of customers

This table shows customers served over the 4 years of the program:

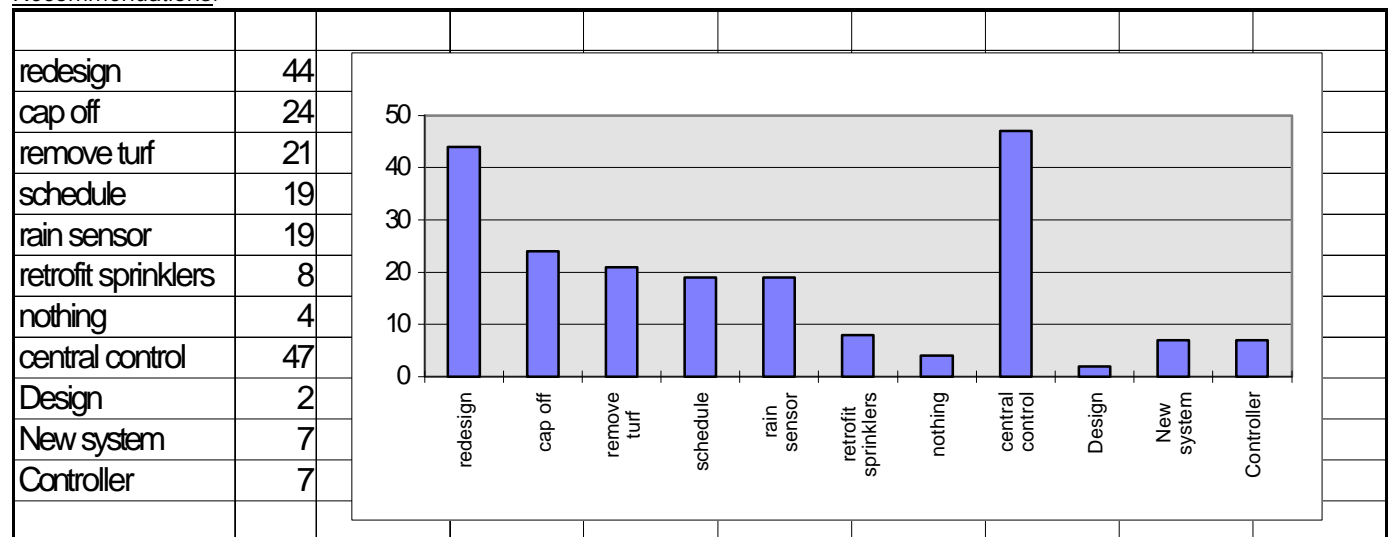
Type of Facility



Assessments / Audits

The Site Assessment's recommendations developed a pattern over time, and the reports became fairly standard. Not all sites were assessed, some improvements resulted in the customer doing the assessment and asking for financial assistance to implement the recommendations. The following table lists the recommendation categories and number of times given. Most Site Assessments received more than one recommendation:

Recommendations:



Many of the systems were in poor condition and the best recommendation for water efficiency was a complete redesign of the system. Implementing a computerized central control irrigation system was recommended for many parks and schools. After that, capping off unnecessary sprinkler heads is a quick and inexpensive method of saving water. SPU frequently recommends eliminating poorly installed and unneeded sprinkler heads.

Removing turf from unneeded areas, such as steep slopes or small areas between walkways, is another top recommendation. Replacing turf with another low water using plant or even no plant material saves water and

maintenance time. Refining the irrigation schedule and installing a rain shut-off device are other common recommendations.

Improvements

The program has funded a total of 29 capital improvement projects over the 4 years, with the dollar amount totaling \$210,960.92.

In order to qualify for a financial incentive, the customer fills out an application explaining the water saving improvement and attaches a bid or cost from a contractor or supply store. SPU evaluates the water use at the site and determines whether the improvement saves water through establishing a "Water Budget." SPU would take the amount of water used at a site and subtract the amount of water the site should be using if it maximized efficiency (what a Water Budget determines). This amount is the potential water savings.

The type of projects funded through financial incentive were:

<u>Retrofit</u>	<u># of Retrofits</u>	<u>Average Total Cost</u>	<u>Average SPU Incentive</u>	<u>Average CCF Savings / Year</u>	<u>Average Levelized Cost</u>
Whole System	9	\$ 12,293	\$ 6,146	539	\$1.92
Cap Off	2	\$ 16,900	\$ 8,450	4,541	\$.31
New system	4	\$ 42,608	\$ 21,304	1,892	\$1.89
Controllers only	2	\$ 2,786	\$ 1,393	1,496	\$.16
Central Control:					
Computer	4	\$ 17,795	\$ 8,897	3,237	\$.46
Connections:					
Controllers	9	\$ 6,197	\$ 2,986	1,745	\$.30
Phone Lines	26	\$ 500	\$ 250	641	\$.07
Remove turf and sprinklers	1	\$ 5,000	\$ 2,750	471	\$.98

The region's major parks departments both participated in the program though purchasing computerized central control systems. A suburban school district was another active participant who also purchased a computerized system. A few multi-family and office parks participated.

Water Savings

Summary of Water Savings: Analyzing irrigation water use data for most sites participating in the WEIP program from 1995-1997 demonstrates water savings comparable to the amount predicted. When analyzing the results, consider two factors: 1) Continued evaluation of irrigation use at these sites will be necessary in order to follow the effectiveness of this program over time; 2) Calculating the levelized costs of this program does not consider the customer's water savings on operation and maintenance or the savings from site assessments only. Therefore the estimated water saving is conservative.

From 1995 to 1996, the average savings for sites investing in capital improvements: 1,171 CCF

The average water savings for Assessment and Audit sites only (no capital improvements): 1,232 CCF

The average levelized cost of saving one CCF of water over 15 years: \$0.85

The average water saving by type of site per year is:

Cemetery:	6,106 CCF
Multifamily:	827 CCF
Office park:	1,156 CCF
Park:	417 CCF
School:	1,126 CCF

Conclusion and Recommendations

This program is cost effective based strictly on financial rebates used to buy water savings. The levelized cost per CCF of water savings is \$0.85 compared to the avoided cost of \$2.13 per CCF for peak season water supply. This means that it would cost Seattle Public Utilities \$0.85 per CCF to implement irrigation water conservation measures compared to \$2.13 per CCF to secure a new water supply for the peak season. Seattle emphasizes summer water conservation since the water demand begins to meet water supply. Because irrigation only occurs during the summer, this program has an added benefit of specifically reducing peak season water consumption.

The information both gathered and dispersed during the site assessments seemed to have a significant impact on saving water. When SPU noted a broken head during a site assessment, for example, the owner was able to fix it immediately rather than let it continue to waste water. Often owners do not observe the sprinklers in operation because the sprinklers run at night. One recommendation SPU makes is for site managers to regularly observe the sprinkler system in operation. The site assessments demonstrated to many managers the benefit of this practice.

It appears that site assessments alone are an effective tool for landscape irrigation water savings. Evaluating practices and suggesting improvements seems to significantly impact water savings.

Seattle Public Utilities' water savings success is realized through operating a customer based water irrigation conservation program. The three major elements that have lead to success are:

- Site Specific: visit each site and tailor the recommendations to the site.
- Recommend both System Management Improvements and Capital Improvements: Good management of an irrigation system is the key to water efficiency.
- Use Visuals: Many financial decision makers do not see the problems in the irrigation system. Take pictures to present with reports. This helps connect the written recommendations with the actual problem.

Water Reuse

Background

Over the past 6 years Seattle Public Utilities has managed a Water Reuse Program to evaluate the commercial demand for treated wastewater effluent for use in non-potable applications including cooling, irrigation, and as industrial process water. The project has been managed in close collaboration with the regional wastewater utility, King County Department of Natural Resources.

The original goal of the Reuse Program was to identify regions with sufficient non-potable water demand to make localized advanced wastewater treatment and distribution of recycled water cost-effective. Resource Conservation staff conducted detailed water use audits of our commercial and irrigation users along Seattle's industrial Duwamish Corridor to determine the potential demand for recycled water.

Results

The results of the water use audits and more than 30 site visits indicated that Seattle's commercial users, as a group, do not have the sufficient demand to make a recycled water distribution loop cost effective compared with the marginal cost of potable water. The audits indicated the following:

- Seattle does not have high-volume (2 mgd or more) mills and factories common to many other cities in the Northwest.
- Very few commercial customers (less than 10) have single, high-volume (100,000 gpd or more) processes that could use recycled wastewater in place of potable water. Most customers have a variety of smaller processes in the 10,000- 25,000 gpd range.
- Most commercial customers have significant opportunities to reduce water consumption from current levels through traditional water conservation and improved process control. The demand reductions resulting from conservation would further reduce the demand for recycled water.
- The cost of retrofit to install separate non-potable water systems in the older commercial properties in the Seattle area is high due to the complex plumbing systems and the need for significant infrastructure upgrades. Installation of secondary distribution systems would be more cost effective for new construction but there is little new construction by high-volume water users.
- Due to the relatively low irrigation demand in the Seattle Region (~18"/year) and, again, the opportunity for other conservation measures to reduce demand for irrigation, few irrigation customers appear to offer cost-effective recycled water irrigation opportunities.

The conclusion reached after our audit and site visit program was that reuse would only be practical and cost effective (less than \$2.48/ccf for summer usage) for specific customers and/or small clusters of customers located near effluent sources on a case-by-case basis and would not, in the near term, be a local or regional solution that could compare favorably with conservation and potable water alternatives. In light of this conclusion, Seattle Public Utilities, in partnership with King County Department of Natural Resources, embarked on an effort to identify customers that would benefit from recycled water in the near-term.

Reuse Projects

Currently, three recycled water projects and a demonstration site use recycled water within our water service area. All of these projects are located within one mile of the regional treatment plants. The demonstration project is served by tanker truck.

- King County's West Point Wastewater Treatment Plant: The facility uses more than 450,000 gallons per day of Class A Recycled Effluent as polymer feed water and for equipment cooling within the treatment plant. This demand displaces an equal demand for potable water.

- Discovery Park Irrigation Project: Discovery Park is located immediately adjacent to King County's West Point Treatment Facility and was planted with an extensive new landscape as part of a treatment plant expansion. While the landscape will no longer need irrigation after establishment, the site used approximately 12,000 gallons per day during the summer of 1998.
- Fort Dent Park Irrigation: Fort Dent is a regional park and sports facility. Beginning in 1998 King County's Renton Water Reclamation Facility provided approximately 30,000 gallons per day of Class A water for irrigation of four baseball fields and for dust suppression on a soccer field.
- Soundscape Lawn and Garden Demonstration: For the past two years, SPU used Class A recycled water provided by truck from King County's Renton Facility to irrigate a turf demonstration plot at the Soundscape site. While the volume used was small the site has helped to demonstrate the safety and value of recycled wastewater as an alternative water resource.
- Duvall Wastewater Treatment Plant: The City of Duvall, WA installed a recycling system to route treatment plant effluent to the process spray bars and use as washdown water. Water for these uses was formally potable water. The system has saved approximately 50,000 gallons per day.

Conclusion

Without demand for a local or regional reuse system, SPU's Water Reuse Program will continue to identify individual or clustered facilities that could cost effectively establish a recycled water project. The program operated as part of the Water Smart Technology Program will continue to identify commercial facilities with close proximity to sources of treated effluent and with high volume processes that are compatible with recycled water quality. We anticipate that over the next 20 years additional cost-effective 1 mgd may be available in the region from recycled water programs.

Lessons Learned in the ICI Sector

What has been learned over the past five years? It is hoped that enough numbers have been provided to allow the reader to appreciate the potential of a commercial water conservation program. When the ICI sector is fully integrated with programs on indoor and outdoor water use, there can be something for just about every commercial customer in which to participate. Both large and small customers can experience significant reductions on a percentage basis of their total water use.

Marketing: From a marketing standpoint, what follows are a variety of techniques that work to varying degrees of success in the effort to get the word out about a program and it's benefits.

What works well:

word of mouth
vendor contacts
sponsor or deliver
training/workshops
irrigation site assessments/one on one contact
well placed articles in newspapers, newsletters, trade journals

What doesn't work well:

general newspaper advertising
trade shows

Program or business dependent :

direct mail
partnering with other agencies
presentations to trade associations
direct contact (cold calling)

Some techniques can be a hit or a miss as determined from the experience of these SPU programs. Depending on what you are trying to accomplish, it is best to use every technique at your disposal in order to guarantee success in your marketing efforts. In a mass marketing effort depicted by the Commercial Toilet Rebate Program, direct mail has worked very well. For commercial landscape irrigation efficiencies, providing customized site assessments and just the one on one contact in the field has been the most successful. WST has had considerable success with word of mouth and the occasional newsletter article or trade group presentation.

In order to expect commercial businesses to participate in conservation programs, the requirements for how much time is allowed to complete projects must be flexible. Most businesses have outside factors that make it difficult, if not impossible, to complete major projects during certain times of the year. Some of these factors include budget cycles, seasonal business cycles, and planning around business operations.

Project specific: After five years the author has learned to be skeptical of chemical services providers (csp), and it can be risky to take anything for granted in a conservation project. Example: commercial laundries offers great potential for water conservation. However, that doesn't guarantee broad acceptance from the csp, who may be motivated by other objectives. This is understandable, but when a customer commits significant financial resources installing a system to reduce water use and operational cost, you would expect support from the csp, especially after having been consulted on formula issues. In at least three examples, this has not been the case. Laundry reuse systems installed under WST have been disabled for at least a short period of time. In two cases this was done by the csp without the customers knowledge. In the third case, the reuse system was implicated in a laundry quality problem by the csp, and the result was discontinuing use of the system. The recommendation is that a clear understanding between the client and the csp must exist at the beginning of start up for this measure.

Much the same problem exists in the chemical treatment of cooling towers. With a SPU contracted consultant recently completing 20 cooling tower evaluations on performance, condition, maintenance and operational practices, and chemical treatment; the results show a disturbing lack of knowledge from some cooling tower operators and surprisingly the chemical treatment people themselves. These are the people who are often looked upon as being the experts, but in reality may not always be doing the right thing for optimizing cooling tower performance and maintenance of the equipment. There apparently is a knowledge gap by cooling tower operators in chemical treatment, and this plays a large role in whether a cooling tower is operating efficiently and whether it can be counted on to provide a full lifetime of service. A utility sponsored training program would be most helpful in helping operators to realize all the efficiency opportunities cooling towers can provide.

Partnering with energy utilities or other agencies can be very beneficial in program promotion. State and local ecology departments and pollution prevention programs can sometimes work hand in hand with the goals and objectives of a commercial water conservation program. Many proven pollution prevention techniques in industry have a direct affect on reducing process water consumption.